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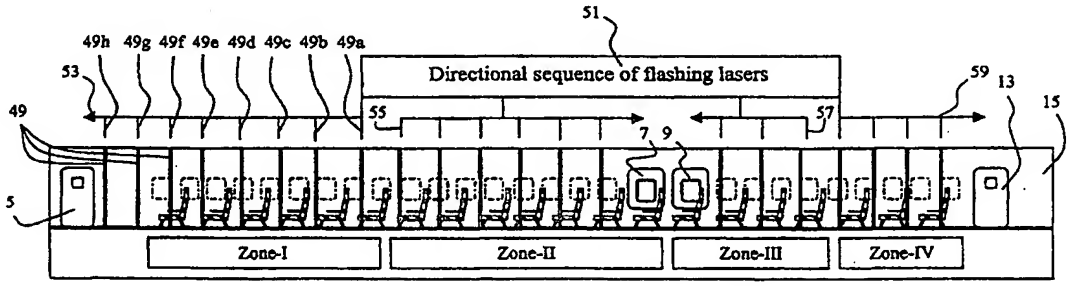

(57) Abstract

A method and system for use in identifying the emergency exits (5, 7, 13) of a structure (such as an aircraft (1), building (60), or ship) in the event smoke is present. Laser generators (50) are mounted along pathways (31) inside of the structure and leading to the emergency exits. The laser generators produce laser beams (49) that are visible to the human eye in the presence of smoke (47). An internal smoke detector (99) and door sensors (10) are attached to a computer (101) and are used in the determination as to activation of the laser beam generators. The door sensors assist in determining if an exit door is open. The computer sequences the plurality of laser beams in an on and off manner so as to lead a human to the nearest open exit.

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EMERGENCY EXIT INDICATOR

SPECIFICATION

BACKGROUND OF THE INVENTION

Fire and the dense smoke generated by fire is a dangerous threat to human life. Commercial airlines, as well as most office buildings, hotels and cruise ships operating in the United States and around the world are required to provide emergency exit identification, in the form of incandescent lighting, affixed above those emergency exits. In the event an aircraft, building or ship requires an emergency evacuation, this lighting feature aids occupants in determining where the emergency exits are located along the aircraft's fuselage or in the walls of a building or ship. In the event an emergency exit is required in a smoke filled environment, the emergency exit incandescent lighting can be obscured or even blocked, depending on the volume and density of the smoke. The present invention incorporates laser beams, which become visible in smoke, to aid in the identification of emergency exit locations within aircraft, office buildings, hotels and cruise ships. The laser beam is invisible to the human eye unless suspended particles in the air are present for the laser beam to reflect from. Smoke which can fill an aircraft cabin, building hallway or ship's corridor is composed of suspended particles in the air. Smoke makes visible the previously invisible laser beams, which are used to identify aircraft, office building, hotel and cruise ship emergency exits.

SUMMARY OF THE INVENTION

It is one object of the present invention to provide improvements to existing aircraft, office building, hotel and cruise ship emergency exit identification lighting.

It is another object of the present invention to provide an emergency exit identification lighting system that is more effective than existing lighting systems when aircraft, office building, hotel and cruise ship environments are filled with smoke.

The present invention provides a method of indicating the location of an exit in an enclosed structure. The structure comprises an area that is structured and arranged to contain humans. The area is in communication with the exit. Smoke is detected in the area. Upon the detection of the smoke, a laser beam is produced inside of the area near the exit to indicate the location of the exit.

In one aspect of the present invention, the laser beam extends in a vertical direction, between a floor and a ceiling of the area.

In still another aspect of the present invention, the area has a pathway leading to the exit. Upon the detection of the smoke, plural laser beams are provided along the pathway. Such plural laser beams illuminate the pathway through the smoke to guide the occupants out of the structure.

In still another aspect of the present invention, the individual laser beams are operated on and off so as to produce a sequence of laser beams leading along a pathway in the direction of the exit.

In still another aspect of the present invention, the structure has at least two exits. The pathway leads to both exits, and both exits have a respective door. The invention determines if the respective door of each exit is open or closed. Then, based upon this determination, the individual laser beams are operated on and off so as to produce a sequence of laser beams leading toward the nearest open exit.

In still another aspect of the present invention, the structure can be either an aircraft, a building or a ship.

In still another aspect of the present invention, the laser beam is a diverging beam. The diverging laser beams can be grouped together.

The present invention also provides a system for indicating the location of an exit in an enclosed structure. The structure comprises an area that is structured and arranged to contain humans. The area is in communication with the exit. The system comprises a smoke detector located in the area. There is also a laser beam generator located inside of the area near the exit. A controller operates the laser beam when smoke is detected in the area. The controller is connected to the detector and to the laser beam generator.

In one aspect of the present invention, the laser beam generator is oriented so as to produce a laser beam in a vertical direction between a floor and a ceiling of the area.

In another aspect of the present invention, the area has a pathway leading to the exit. Plural laser beam generators are located along the pathway. The laser beam generators are connected to the controller. The controller operates the plural laser beam generators so as to produce plural laser beams along the pathway upon the detection of the smoke.

In another aspect of the present invention, the controller operates the individual laser beam generators upon the detection of the smoke so as to produce a sequence of the laser beams leading along the pathway to the exit.

In still another aspect of the present invention, the structure has at least two exits. The pathway leads to both exits, with both exits having a respective door. The system has a sensor located at each respective door. The respective sensor determines if the respective door is opened or closed. The controller is connected to the sensors. The controller operates the laser beam generators on and off so as to produce a sequence of the laser beams toward the nearest open exit.

In still another aspect of the present invention, the structure is an aircraft.

In still another aspect of the present invention, a lens is located adjacent to the laser beam generator, which lens produces a diverging laser beam. Also, plural laser beam generators are each provided with a lens, and are arranged so as to produce a group of diverging laser beams.

The present invention provides a method of utilizing laser beams to aid in the identification of aircraft, office building, hotel and cruise ship emergency exits. The laser beam has a characteristic of being invisible to the human eye while passing through clean air, but when suspended particles in the air are present, the invisible light of the laser beam reflects off of those suspended particles and becomes visible to the human eye. Smoke which can fill aircraft, office building, hotel and cruise ship areas is composed of suspended particles in the air. The smoke which can fill aircraft, office building, hotel and cruise ship environment, make visible the previously invisible laser beams. Vertical laser beams are spaced parallel to the longitudinal axis of an aircraft cabin, office building and hotel hallways, and ship corridors; and flash in a sequenced motion to guide passengers in the direction of the nearest emergency exit. This flashing of the laser beams in a sequenced motion is similar to the flashing sequence of the directionally sequenced yellow flashing lights used to advise motorists as to the closing of one or more of the lanes of a highway or roadway during construction. Motorists can be advised as to the proper direction to merge in traffic, without having to be audibly or verbally informed on an individual basis.

BRIEF DESCRIPTION OF THE DRAWINGS

Although the features of this invention, which are considered to be novel, are expressed in the appended claims, further details as to preferred practices and as to the further objects and features thereof may be most readily comprehended through reference to the following description when taken in connection with the accompanying drawings, wherein:

FIG. 1 is a side view of a typical commercial airliner with emergency exit portals.

FIG. 2 is a transverse cross-sectional view of the passenger cabin of a typical commercial airliner taken through lines II-II of FIG. 1.

FIG. 3 is a transverse cross-sectional view of the cabin of FIG.2, filled with smoke.

FIG. 4 is a transverse cross-sectional view of the cabin of FIG.2, filled with smoke and with a narrow laser beam illuminated.

FIG. 5 is a transverse cross-sectional view of the cabin of FIG.2, filled with smoke and with plural, delta shaped, laser beams illuminated.

FIG. 6 is a longitudinal cross-sectional view the cabin of the commercial airliner of FIG. 1.

FIG. 7 is a longitudinal cross-sectional view of the cabin of the commercial airliner of FIG. 6, illustrating directional sequence of flashing lasers.

FIG. 8 is an aisle-side view of a typical commercial airliner seat.

FIG. 9 is a plan view of a typical hallway corridor for either an office building, hotel or ship.

FIG. 10 is a schematic view of a portion of the invention in accordance with a preferred embodiment.

FIG. 11 is a block diagram of the invention in accordance with a preferred embodiment.

FIG. 12 is a block diagram of an alternate configuration of the invention in accordance with a preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference numerals designate corresponding parts throughout the several views and more particularly to FIG. 1 thereof, there is shown a typical commercial airliner 1 consisting of an aircraft fuselage 3, with forward emergency exit portal 5, emergency exit portals 7 and 9 are located over the aircraft wing 11, and aft emergency exit portal 13. Identical emergency exit portals to those stated above are located at corresponding locations on the opposite side of aircraft fuselage 3.

Referring now to FIG. 2, there is shown a transverse cross-sectional, view of the passenger cabin 15 of aircraft fuselage 3. Within passenger cabin 15 there is a cabin floor 17 with cargo compartment 19 below, and an example of one of the many rows

of passenger seats 21, 22, 23, 24, 25. Between passenger seats 22 and seats 23 there is an aisle 31 to allow passengers to travel the length of the passenger cabin 15. On the floor and on either side of aisle 31, are existing emergency exit row identification lights 33 and 35 which are positioned at the rows adjacent to over wing emergency exit portals 7 and 9 (FIG. 1). In addition to existing emergency exit row identification lights 33 and 35 are existing emergency exit row identification lights 37 and 39 located above the over wing emergency exit portals 7 and 9. In addition to existing emergency exit row identification lights 33, 35, 37 and 39 there is an existing emergency exit row identification light 41 attached to the ceiling 43 of the passenger cabin 15 near the over wing emergency exit portals 7 and 9. Also attached to the ceiling 43 of passenger cabin 15 and without obstructing the visibility of existing emergency exit row identification light 41, is this invention enclosed in its exterior housing 45.

Referring now to FIG. 3, there is shown a transverse cross-sectional view with smoke 47 filling the volume of the passenger cabin 15 of aircraft fuselage 3. Smoke 47, contained between the cabin ceiling 43 and the cabin floor 17 impairs occupant visibility and hinders attempts to visually identify the aircraft emergency exits.

Referring now to FIG. 4, there is shown a transverse cross-sectional view of smoke 47 filling the volume of the passenger cabin 15 of aircraft fuselage 3. Smoke 47 is contained between the cabin ceiling 43 and the cabin floor 17. Laser beams 49 are directed from the ceiling 43 to the floor 17 along the aisle 31 of the aircraft. Laser beams 49 which are invisible to the human eye when projected through clear air, are made visible to the human eye as the laser beams 49 reflect off of suspended particles in air which form smoke 47. Laser beams 49 which are projected through clear air generate a dot-of-light 54, at the end of laser beam 49, on the floor 17, or whatever surface they are focussed at. Dot-of-light 54 is focussed on cabin floor 17 in a normal situation. In the event debris is scattered during an aircraft crash landing, dot-of-light 54 will re-appear on the top of any new surface of possible multiple layers of debris which may collect on the floor 17. Laser beams 49 may be generated in various colors, depending on customer preference. Laser beams 49 are capable of being made to flash periodically or remain continuously illuminated. Laser beams 49 are capable of being made to flash in staggered or pulsing sequence to aid passengers in determining the direction of the nearest aircraft emergency exit. As opposed to the scattering of the incandescent light of the existing aircraft emergency exits, the tight focusing of the light of laser beams 49 penetrate the smoke 47 to extend from the ceiling 43 to the floor 17. Alternatively, the direction of laser beams 49 may be reversed from floor 17 to ceiling 43. The laser beams 49 need not be vertically oriented. They can be

horizontal or some other orientation. It is believed that vertical orientation would provide the least ambiguity in locating an exit. The invention which is enclosed in exterior housing 45 can be mounted flush within the floor 17, mounted flush within ceiling 43 or as an alternative mounted to the overhead baggage compartments or walls of aircraft fuselage 3 (not shown).

Referring now to FIG. 5, there is shown a transverse cross-sectional view of dense smoke 42 and less dense smoke 44, filling the volume of the passenger cabin 15 of aircraft fuselage 3. Dense smoke 42 and less dense smoke 44 are contained between the cabin ceiling 43 and the cabin floor 17. Plural laser beams 49 are mounted flush within ceiling 43 and oriented towards floor 17. One or more of laser beams 49 can be adjusted from a narrow column of light (as shown in FIG.4), to generate a diverging (such as delta, fan or cone shaped) pattern of light. The use of plural laser beams 49 adjusted to generate a diverging beam of light, allows for the creation of an apparent wall of light 48. Wall of light 48, as an additional aid to passengers in determining the nearest aircraft emergency exit, is positioned adjacent to the emergency exit and installed perpendicular to the longitudinal axis of the aircraft cabin. As passengers attempt to exit the aircraft and progress along the aisle of the aircraft cabin, wall of light 48 will alert passengers when they have reached an emergency exit. The visibility of the laser beams 49 can be enhanced by expanding the individual laser beams and by grouping laser beams together. Individual laser beams can be expanded by adjusting lens 52 (see FIG. 9) to produce divergence, or to produce a larger diameter beam. The lens 52 is located adjacent to the laser beam generator. Even in dense smoke 42, diverging laser beams 49 will be visible, especially if the laser beam generators are located in the ceiling 43. This is because smoke rises and accumulates towards the ceiling 43. Nearer to the floor 17, you may find less dense smoke 44. With diverging laser beams, such as shown in FIG. 5, the laser beams are more concentrated near the ceiling 43, where the smoke is the densest. Thus, the laser beams 49 will penetrate the dense smoke 42 near the ceiling 43 and make visible the wall of light 48, reflecting off of the fewer suspended particles in air, which form the less dense smoke 44 near the floor 17, thus illuminating a perpendicular exit pathway, across cabin 15, along the floor 17.

Referring now to FIG. 6, there is shown a longitudinal cross-sectional view of passenger cabin 15 of aircraft fuselage 3. Seats 21, 22, 23, 24, 25 make up one of the many rows of seats within passenger cabin 15 and are equally spaced throughout passenger cabin 15, and located between forward exit portal 5 and aft exit portal 13. Wing exit portals 7 and 9 are located between forward exit portal 5 and aft exit portal

13. Each exit portal 5,7,9 and 13 have a hatch proximity sensor 10 to verify if that portal is open or closed.

Referring now to FIG. 7, there is shown a longitudinal cross-sectional view of passenger cabin 15. Plural laser beams 49 are produced by laser generators 50 such as laser diodes (see FIG. 9) and are spaced equally along the longitudinal axis of passenger cabin 15. Other types of laser generators could be utilized. The laser beam generators 50 can be operated so as to turn on and off. Computer 101 incorporates electronics and/or software designed to flash in a preprogrammed sequence 51, to alert and guide passengers as to the nearest emergency exit. In this illustrated configuration, passenger cabin 15 is divided into four zones I, II III, IV. Identical rows of seats 21-25 are in each of the four zones. In the event smoke fills passenger cabin 15, passengers sitting in rows of seats located in zone-I will see laser beams 49 flashing in sequence 53 which will direct them to the nearest emergency exit portal 5. An example of the sequence 53 is as follows, laser beam 49a is produced, while the other laser beams 49b - 49h are off. Then, laser beam 49b is illuminated. Shortly afterwards, laser beam 49a is turned off. Then, laser beam 49c is illuminated. Shortly afterwards, laser beam 49b is turned off. Then, laser beam 49d is illuminated. Shortly afterwards laser beam 49c is turned off. This sequence continues until laser beam 49h (closest to the exit 5) is illuminated and turned off. The sequence then repeats itself. Such sequencing guides nearby occupants to the exit 5. The occupants have a natural tendency to follow the beams of light along the aircraft aisle. Likewise, passengers sitting in rows of seats located in zone-II will see laser beams 49 flashing in sequence 55 which will direct them to the nearest emergency exit portal 7 which is aft of their seats. Passengers sitting in rows of seats located in zone-III will see laser beams 49 flashing in sequence 57 which will direct them to the nearest emergency exit portal 9. Passengers sitting in rows of seats located in zone-IV will see laser beams 49 flashing in sequence 59 which will direct them to the nearest emergency exit portal 13. Sequences 53 and 57 begin at the aft portion of the respective section and progress forward to the respective exit. Sequences 55 and 59 begin at the forward portion of the respective section and progress aft to the respective exit. If an exit door is closed, then the laser beams located in that zone flash in a sequence so as to direct passengers to the nearest open exit. For example, if exit door 5 is closed, this condition is detected by the respective door sensor 10. The laser beams 49 in zone I are then sequenced in reverse, from forward to aft. In addition, the laser beams 49 of zones I and II are sequenced in a coordinated manner as a single zone toward exit 7. If the exit door 5 is later opened, then the two zones I and II are operated separately as described above. The rate of

sequencing between each of the individual laser beams 49 can be adjusted to be slow or fast.

Referring now to FIG. 8, there is shown an aisle-side view of typical commercial airliner seats 22. Seats 22 are equally spaced along the aircraft cabin floor 17. Aircraft cabin floor 17 contains existing floor exit lights 33. System housing 45 is located on the aisle-side of the seat cushion base of the seat 22. The system housing 45 contains multiple laser beam generators 50. The multiple laser beam generators 50 are mounted to direct laser beams 49 in various directions. In the preferred embodiment two of the laser beam generators 50 are directed in a forward and aft direction, parallel to, and along aircraft cabin floor 17, with a remaining laser beam generator 50 directed perpendicular to and focussed on the aircraft cabin floor 17.

Referring now to FIG. 9, there is shown a plan view of a typical building floor plan 60 with ten rooms numbered 61-70. Each of the ten rooms numbered 61-70 have respective access doors numbered 71-80. Each of the ten rooms numbered 61-70 are connected by a common hallway 81. Hallway 81 leads in either direction to one of two emergency exits 87, 89. Emergency exits 87, 89 are accessed through emergency exit doors 83, 85. Emergency exits 87, 89 are identified with illuminated exit signs 86, 88. Installed into the ceiling of hallway 81 are lasers that produce laser beams 49, as described in detail in (FIG. 7) above. The laser beams are vertically oriented, extending to the floor. Laser beams 49 are sequenced to flash in a manner as to advise the building occupants the direction of the nearest emergency exit. In the event dense smoke fills hallway 81 to an extent that emergency exit identification lighted signs 86, 88 are not visible, laser beams 49 located in the hallway 81 outside of doors 71, 72, 73, 76, 77 and 78 are flashing in sequence 91, alerting and advising the building occupants exiting those rooms, the direction of the nearest emergency exit access door 85. In the event dense smoke fills hallway 81 to an extent that emergency exit identification lighted signs 86, 88 are not visible, laser beams 49 located in the hallway 81 outside of doors 74, 75, 79 and 80 are flashing in sequence 93, alerting and advising the building occupants exiting those rooms, the direction of the nearest emergency exit access door 83. The view of this typical building floor plan 60 is similar to the configuration of rooms aboard a typical cruise ship. In the event smoke fills the hallway of a typical cruise ship, laser beams 49 can be sequenced in a similar manner to alert and advise the passengers aboard that ship the direction of the nearest emergency exit.

Referring now to FIG. 10, there is shown a schematic view of one of multiple, like portions of the invention in accordance with a preferred embodiment. The invention incorporates plural laser beam 49 generating laser diodes 50 enclosed in a

housing 45. The housing is installed in the ceiling of the relevant structure. Alternatively, the laser beam generators can be installed on walls, in floors, or on furniture and fixtures. Multiple laser diodes 50 are connected via wiring harness 46 to a control box 95. This configuration of the invention can be flush mounted to the ceiling or flush mounted to the floor.

Referring now to FIG. 11, there is shown a block diagram view of the invention. Control box 95 is connected to a power source or commercially available battery 97 via power cord 98. Plural, commercially available smoke detectors 99, and commercially available computer 101 are enclosed in the control box 95. The smoke detectors 99 are connected to inputs of the computer 101. Control box 95 with one or more smoke detectors 99 is installed in a manner to maximize the effectiveness of smoke detectors' 99 ability to detect smoke. The laser diodes 50 are connected to outputs on the computer 101. Multiple commercially available laser diodes 50 are within housings 45. If door sensors 10 are used, they are also connected to inputs of the computer 101. (FIG. 10 shows just a sampling of door sensors 10.) As smoke is detected by smoke detector 99, computer 101 uses software programs 103 to interrogate signals from all emergency exit door sensors 10, which determine whether the emergency exit doors are open or closed (FIG. 6). This information is used to determine the proper sequence of flashing for the plural laser diodes 50. Laser diodes 50 may be powered upon the detection of smoke alone, or by a manual override auxiliary switch 105. Laser diodes 50 produce a beam of focused invisible light, which is made visible when laser beam 49 light is reflected by the suspended particles in the air. Battery 97 is used to power all of the independent components of the invention, through control box 95.

Referring now to FIG. 12, there is shown a block diagram of an alternate configuration of the invention in accordance with a preferred embodiment. Laser beam generator 50 is contained within a system housing 45. In this configuration laser beam generator 50 is attached to a motor 107 utilizing an asymmetrical wheel 109 and fulcrum 111, to cause the laser beam 49 to be rapidly moved within a defined area and produce the illusion of laser beam 49 painting a defined area with laser beam 49. The movement of laser beam 49 will allow the laser beam 49 a greater opportunity of being unobstructed by debris which might find itself in between the laser beam generator 50 and its intended target.

The configuration of FIG. 12 can be used in the same locations as the previously discussed laser beam generators 50. For example, the configuration can be used in the ceiling 43 of the aircraft (see FIG. 2), along the aisle side of seats (as

shown with laser beam generators 50 in FIG. 8), or in a building environment (as in FIG. 9). One typical application is to mount the configuration of FIG. 12 in an aircraft ceiling and point the laser beams toward an aircraft exit door. Moving the beam allows the exit door to be illuminated with a moving light, thereby enhancing the visibility of the exit door.

In a practical application of the preferred embodiment of this new invention, the computer will perform the following tasks:

1. Monitor to detect smoke in the passenger cabin
2. Monitor to detect open aircraft emergency exits
3. Determine available emergency exits
4. Illuminate and properly sequence the laser diodes to direct the occupants to the nearest open exit.

Although the invention has been described as using laser beams that are invisible in clear air, the laser generators could be adapted to project laser beams which are visible in clear air.

Although an exemplary embodiment of the invention has been disclosed and discussed, it will be understood that other applications of the invention are possible and that the embodiment disclosed may be subject to various changes, modifications, and substitutions without necessarily departing from the spirit of the invention.

CLAIMS

1. A method of indicating a location of an exit in an enclosed structure, the structure comprising an area that is structured and arranged to contain humans, the area being in communication with the exit, comprising the steps of:

a) detecting an event in the area, which event potentially threatens the lives of humans in the area;

b) upon the detection of the event, producing a laser beam inside of the area near the exit to indicate the location of the exit.

2. The method of claim 1 wherein the step of detecting an event further comprises the step of detecting smoke that exceeds a predetermined threshold.

3. The method of claim 1 wherein the step of detecting an event further comprises the step of detecting a shock that exceeds a predetermined threshold.

4. The method of claim 1 wherein the structure is an aircraft.

5. The method of claim 1 wherein the structure is a building.

6. The method of claim 1 wherein the laser beam extends above and along a pathway leading toward the exit.

7. The method of claim 1 wherein the laser beam extends from a location above a floor in a direction toward the floor.

8. The method of claim 1 further comprising the step of operating plural laser beams on and off so as to produce a sequence of the laser beams leading along the pathway toward the exit.

9. The method of claim 8 wherein the structure has at least two exits, with the pathway leading to both exits, both exits having a respective door, further comprising the steps of:

a) determining if the respective door of each exit is opened or closed;

b) operating the individual laser beams on and off so as to produce a sequence of laser beams leading toward the nearest open exit.

10. The method of claim 1 wherein the laser beam comprises a diverging beam.

11. The method of claim 1 further comprising moving the laser beam so as to enhance its visibility.

12. A system for indicating a location of an exit in an enclosed exit, the system comprising an area that is structured and arranged to contain humans, the area being in communication with the exit, comprising:

a) an event detector located in the area, which event potentially threatens the lives of humans in the area;

b) a laser beam generator located inside of the area near the exit;

c) a controller for operating the laser beam when the event is detected in the area, the controller being connected to the detector and to the laser beam generator.

13. The system of claim 12 wherein the event detector further comprises a smoke detector.

14. The system of claim 12 wherein the event detector further comprises a shock detector.

15. The system of claim 12 wherein the structure is an aircraft.

16. The system of claim 12 wherein the structure is a building.

17. The system of claim 12 wherein the laser beam extends above and along a pathway leading toward the exit.

18. The system of claim 12 wherein the laser beam extends from a location above a floor in a direction toward the floor.

19. The system of claim 18, wherein the controller operates plural laser beams on and off so as to produce a sequence of the laser beams leading along the pathway toward the exit.

20. The system of claim 19, wherein the structure has at least two exits, with the pathway leading to both exits, both exits having a respective door, further comprising:

a) means for determining if the respective door of each exit is opened or closed, said means for determining if the respective door of each exit is opened or closed being connected to the controller;

b) the controller operates the individual laser beams on and off so as to produce a sequence of the laser beams leading toward the nearest open exit.

21. The system of claim 12 wherein the laser beam is a diverging beam.

22. The system of claim 12 further comprising:

a) means for moving the laser beam generator, said means for moving the laser beam generator being connected to the controller;

b) the controller operating the means for moving the laser generator so as to cause the laser beam to move in the area so as to enhance its visibility.

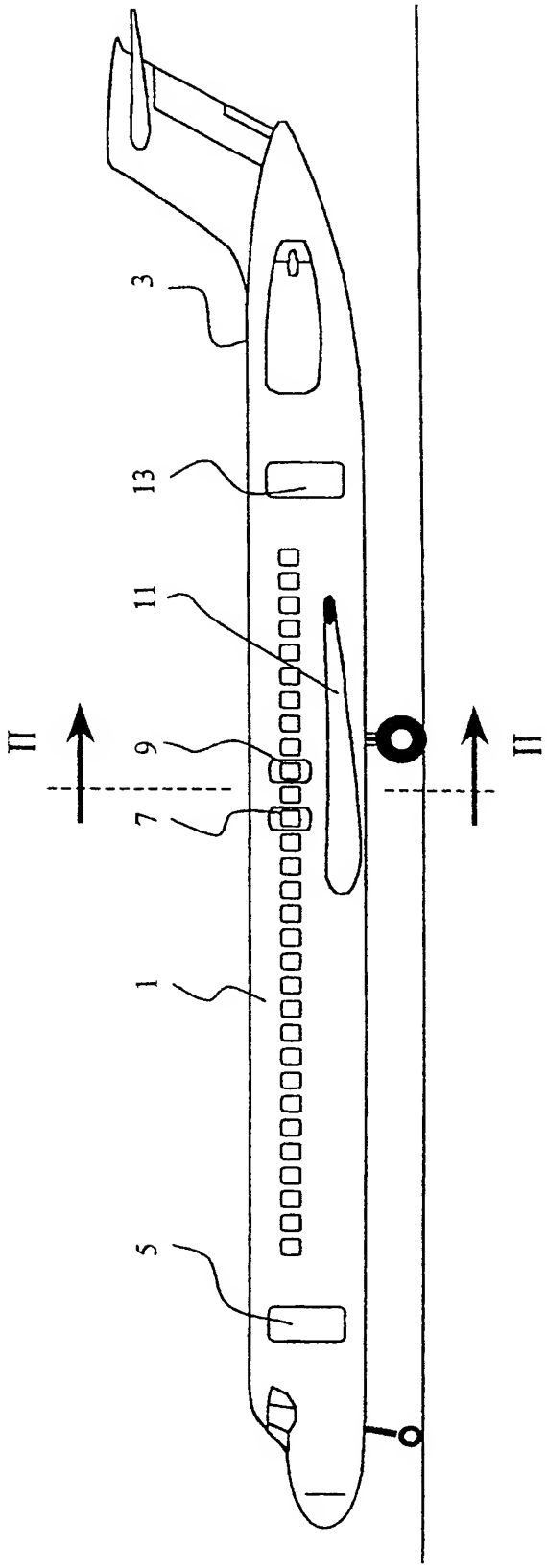


FIG. 1

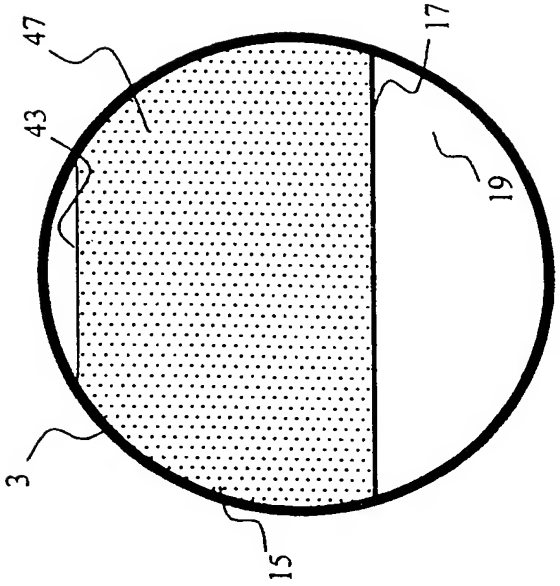


FIG. 3

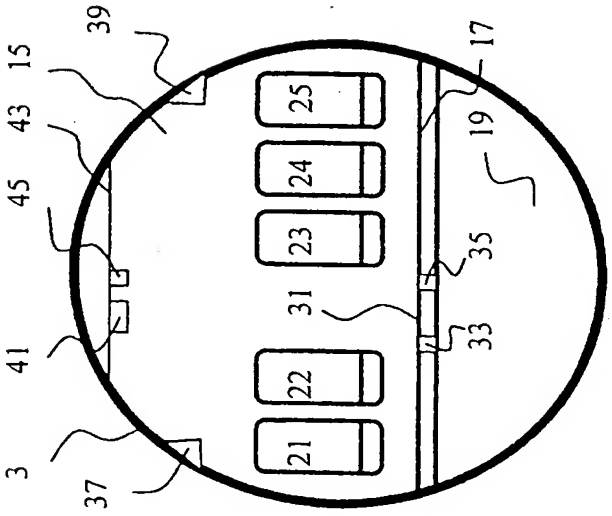


FIG. 2

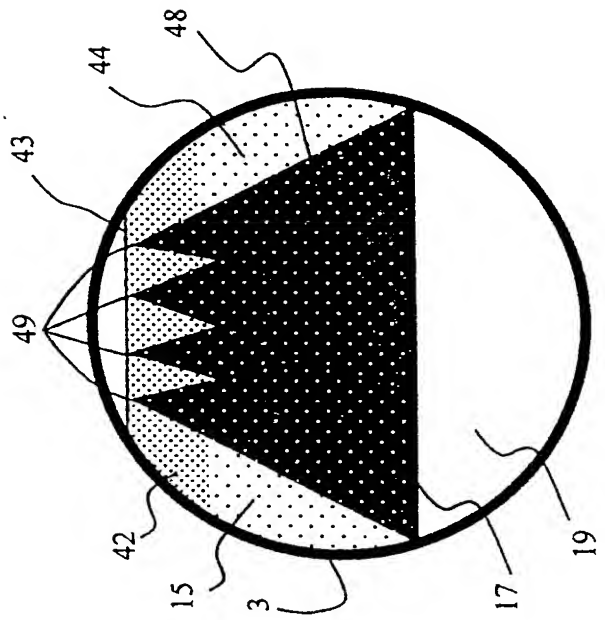


FIG. 5

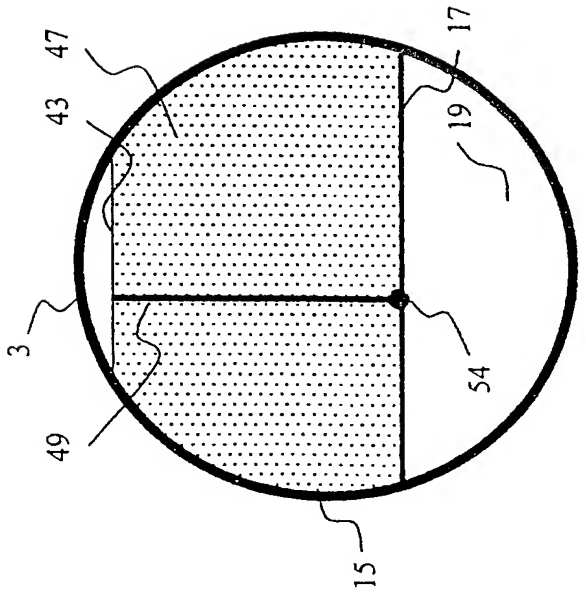


FIG. 4

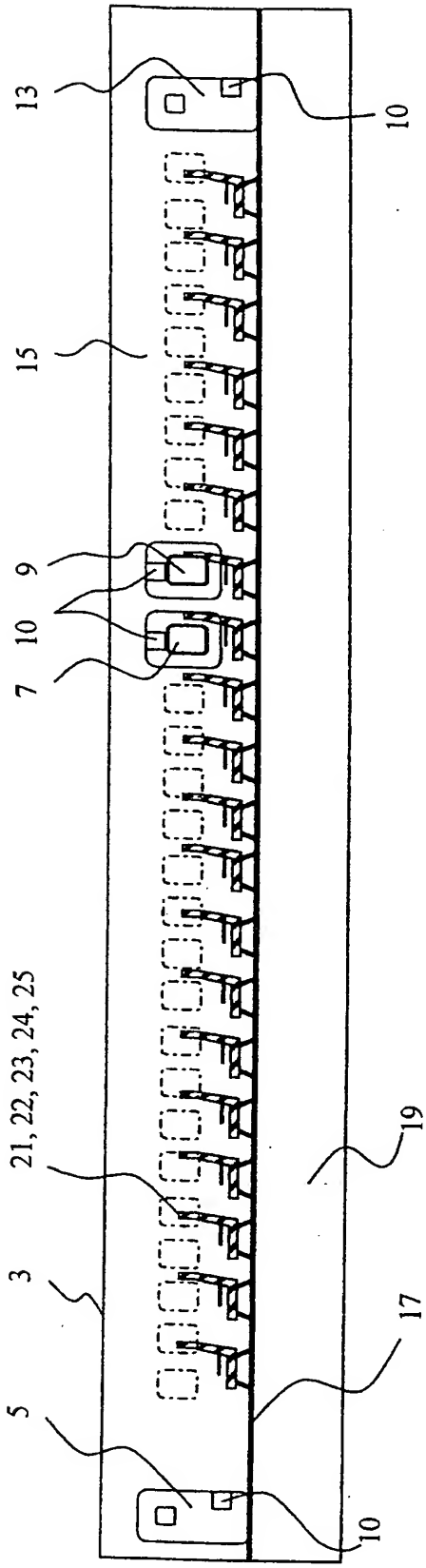


FIG. 6

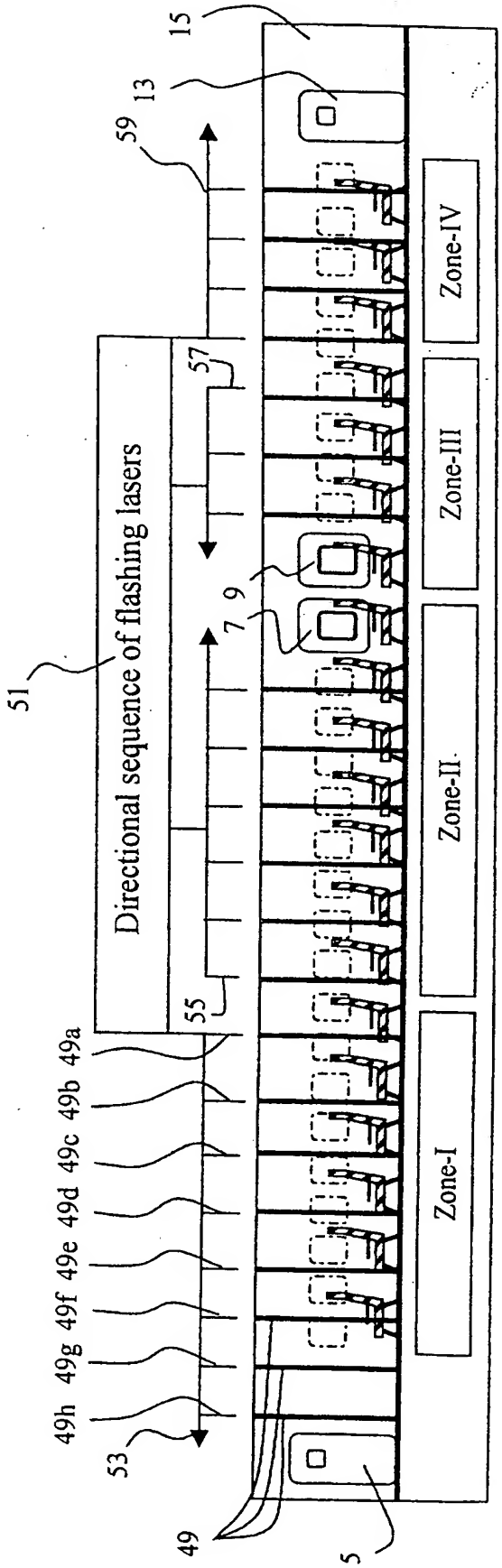


FIG. 7

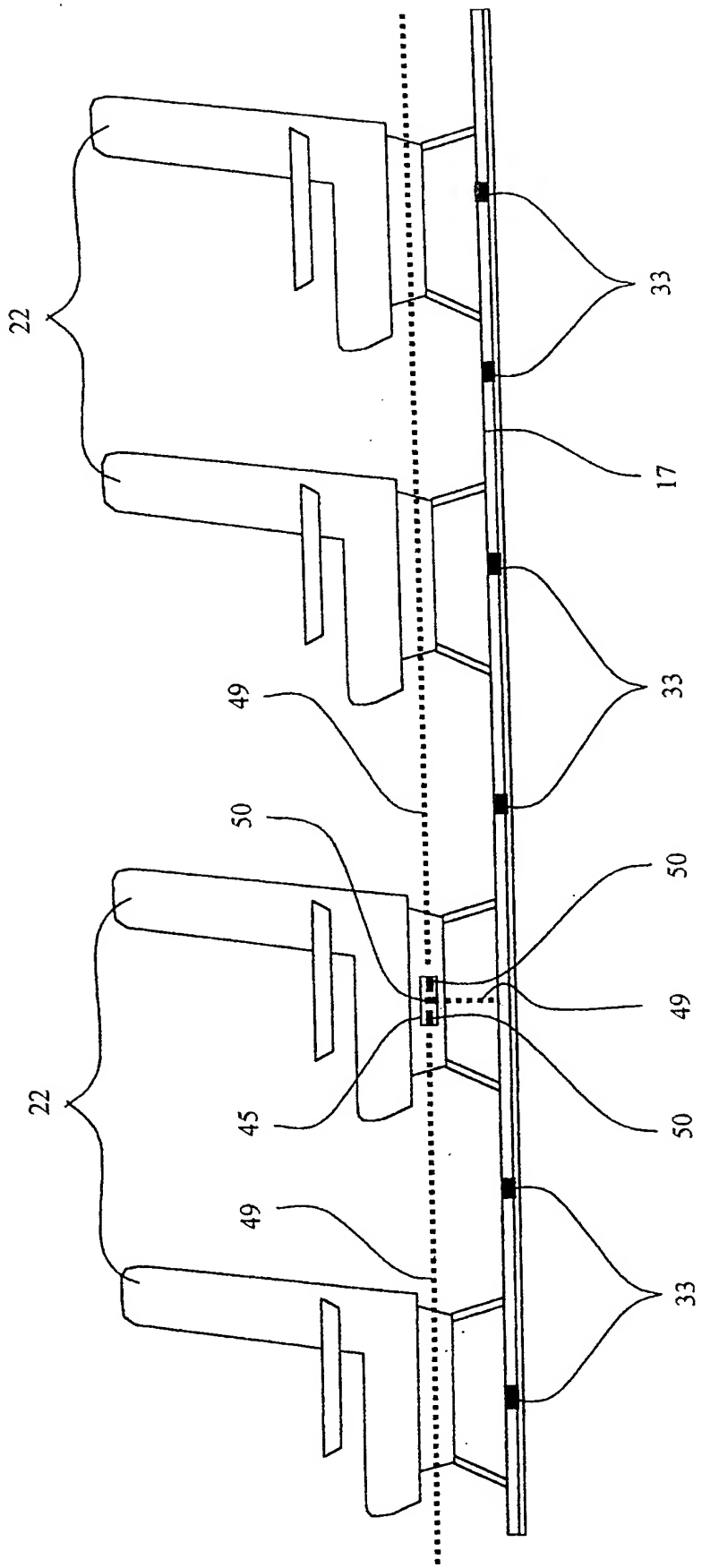


FIG. 8

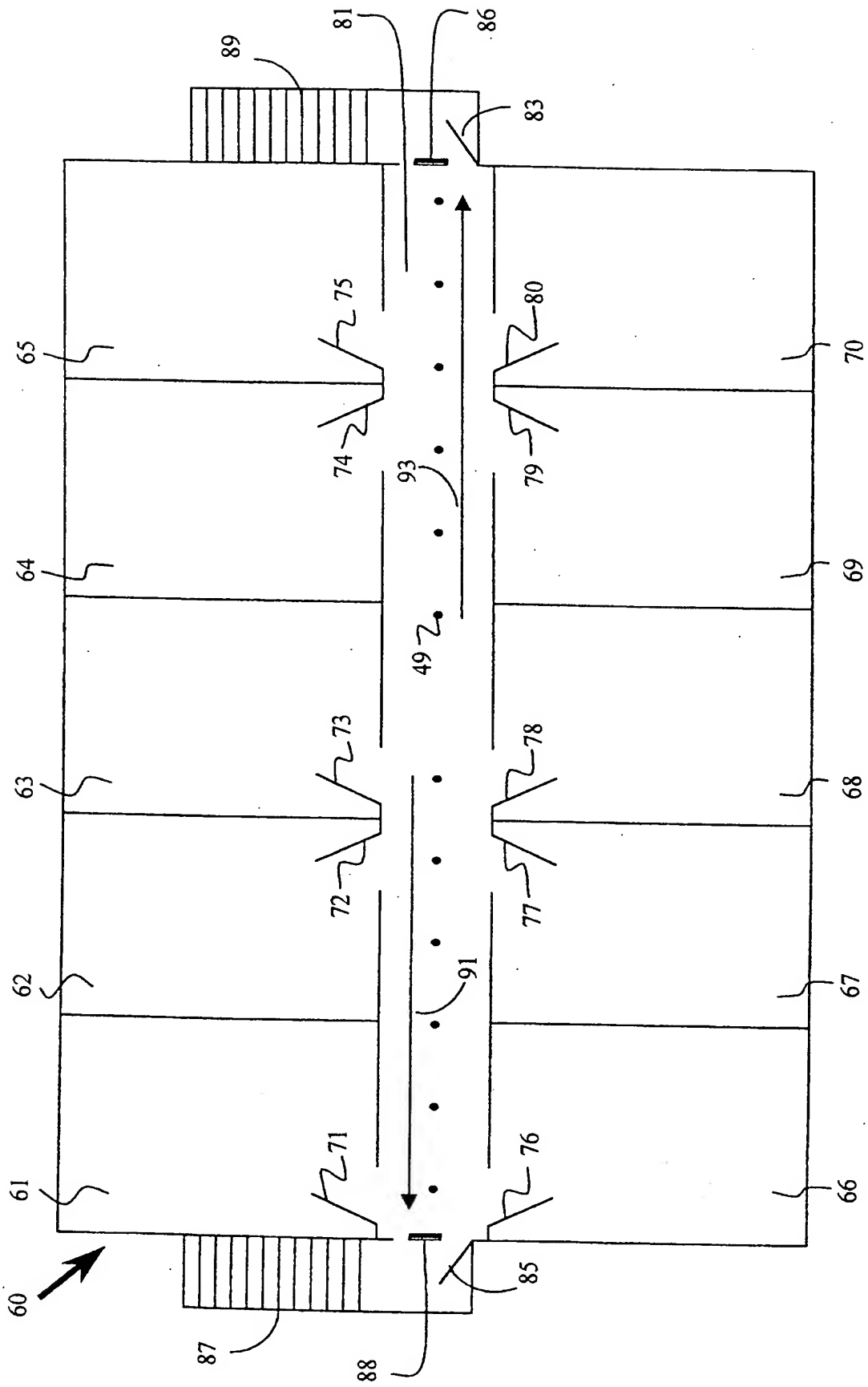
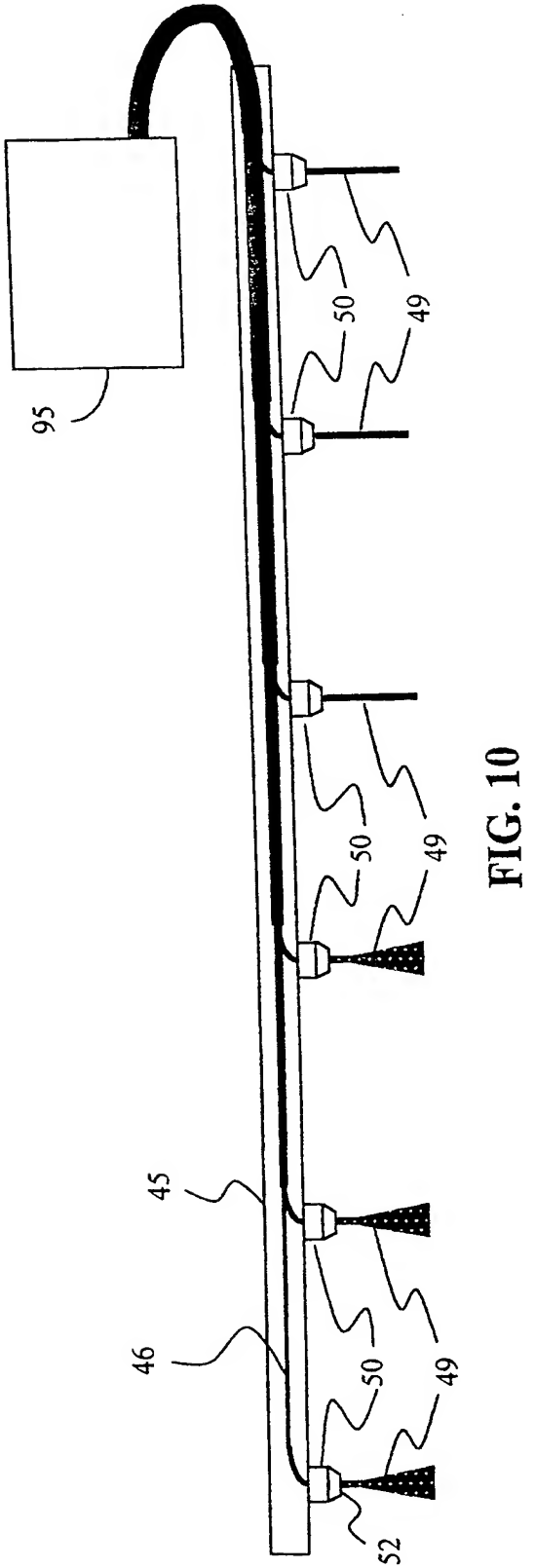


FIG. 9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49
52

FIG. 10

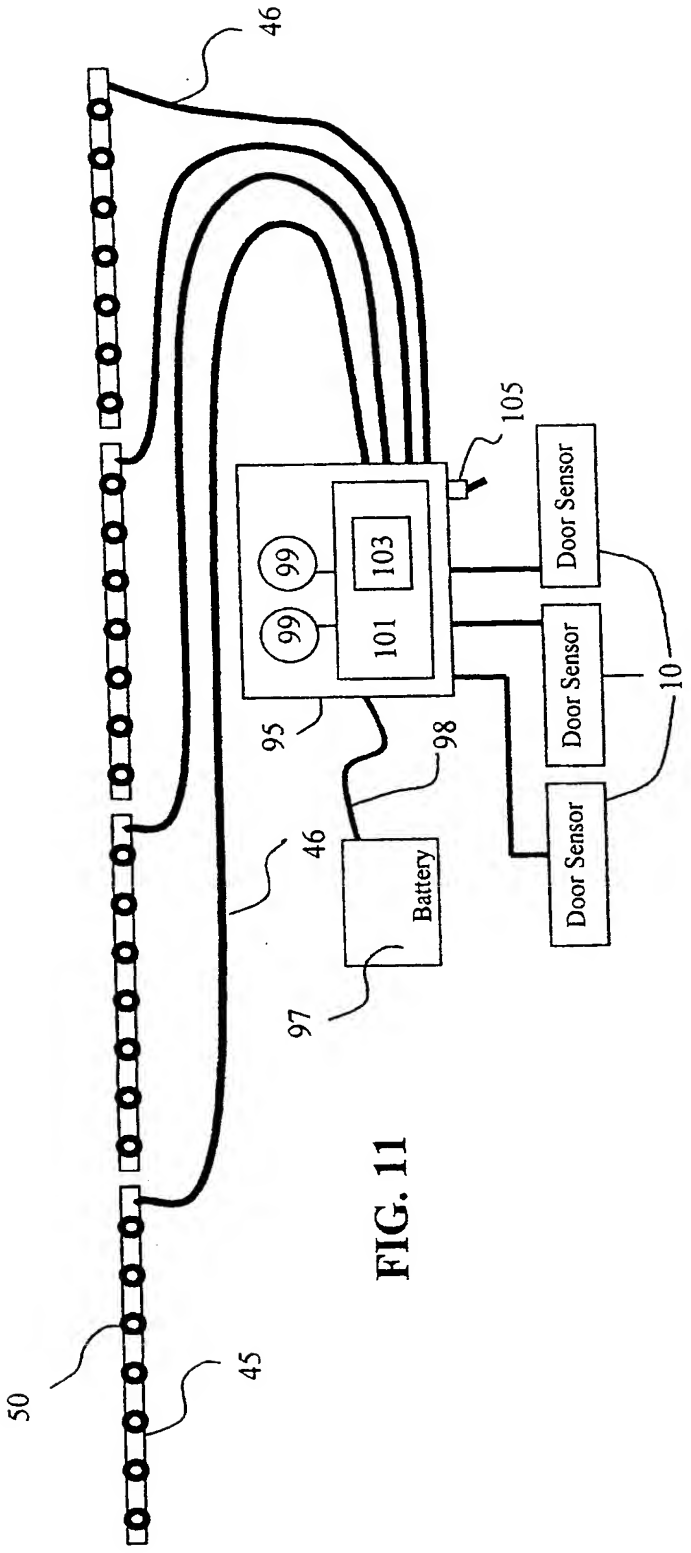
46
105
99
99
103
101
Door Sensor
Door Sensor
Door Sensor
10
95
98
46
Battery
97
50
45

FIG. 11

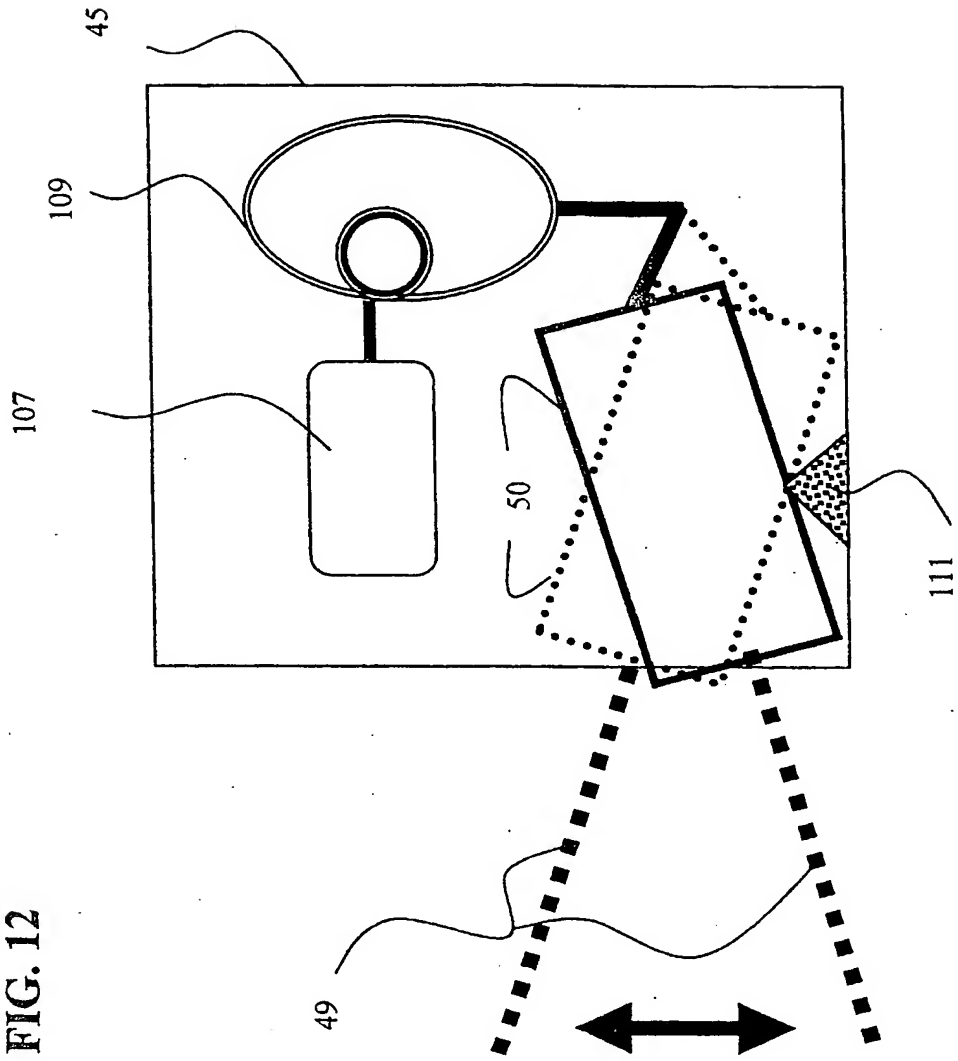

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/17760

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B64C 1/10
US CL :244/121

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 244/121

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS
search terms: emergency exit, laser

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,572,183 A (Sweeney) 05 November 1996 (05.11.96), see entire document.	1-3, 5-8, 10-14, 16-19, 21, 22 --- 4, 15
X ---- Y	US 5,140,301 A (Watanabe) 18 August 1992 (18.08.92), see entire document.	1-3, 5-8, 10-14, 16-19, 21, 22 --- 4, 15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 15 DECEMBER 1998	Date of mailing of the international search report 14 JAN 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer WOODROW ELDRED Telephone No. (703) 306-4151

Form PCT/ISA/210 (second sheet)(July 1992)*